

NE-1150

- 13 -

What is claimed is:

- 1           1.     A constant current circuit including a plurality of resistors  
2     formed on a semiconductor substrate, comprising:  
3           a first current source for producing a first current of constant  
4     magnitude regardless of resistance variations which can occur uniformly in  
5     said resistors; and  
6           a second current source for producing a second current of magnitude  
7     which is inversely variable with said resistance variations,  
8           said first and second current sources being connected to each other for  
9     producing an output current which is equal to a difference between said first  
10    and second currents.
- 1           2.     The constant current circuit of claim 1, wherein said second  
2     current is variable depending on an base-emitter voltage of a transistor.
- 1           3.     The constant current circuit of claim 1, wherein said second  
2     current is variable depending on a power-line voltage.
- 1           4.     The constant current circuit of claim 1, wherein said second  
2     current source is a band-gap type constant current source.
- 1           5.     A constant current circuit including a plurality of resistors  
2     formed on a semiconductor substrate, comprising:  
3           a first group of parallel transistors having emitters connected via  
4     respective resistors to a voltage source and having collectors connected  
5     together to an output terminal;

NE-1150

- 14 -

6 a second group of parallel transistors having emitters connected via  
7 respective resistors to said voltage source and having collectors connected to  
8 each other;

9 a constant current source connected between the collectors of said  
10 second group of transistors and ground to produce a constant current, said  
11 first and second groups of transistors having bases connected together to  
12 form a current mirror, whereby a current equal to said constant current is  
13 drawn by said first group of transistors to said output terminal; and  
14 transistor-resistor circuitry for drawing a current inversely variable  
15 with uniform resistance variations of said semiconductor substrate from said  
16 output terminal to ground.

1 6. The constant current circuit of claim 5, wherein said transistor-  
2 resistor circuitry comprises:

3 at least one third transistor having an emitter connected via a resistor  
4 to said voltage source and a collector connected to a circuit node, whereby a  
5 current whose magnitude is equal to  $1/M$  of said constant current is drawn  
6 by said third transistor to said circuit node, where  $M$  is the number of  
7 transistors provided in each of said first and second groups of transistors;

8 a fourth transistor having a collector connected to said output terminal  
9 and an emitter connected to ground via a resistor, said fourth transistor  
10 having a base electrode connected to said circuit node; and

11 a fifth transistor having a collector connected to said circuit node and  
12 an emitter connected to ground via a resistor, said fifth transistor having a  
13 base electrode connected to the emitter of said fourth transistor.

1 7. The constant current circuit of claim 5, wherein said transistor-

NE-1150

- 15 -

2 resistor circuitry comprises:

3 a pair of resistors connected in series between said voltage source and  
4 ground to form a circuit node therebetween; and

5 a third transistor having a collector connected to said output terminal  
6 and an emitter connected to ground via a resistor, said third transistor having  
7 a base electrode connected to said circuit node.

1 8. The constant current circuit of claim 5, wherein said transistor-  
2 resistor circuitry comprises:

3 third and fourth transistors having emitters connected via respective  
4 resistors to said voltage source and having bases connected together to the  
5 bases of said first and second groups of transistors to produce from each of  
6 the third and fourth transistors a current whose magnitude is equal to  $1/M$  of  
7 said constant current, where  $M$  is the number of transistors provided in each  
8 of said first and second groups of transistors;

9 a group of fifth transistors having collectors connected together to the  
10 collector of said third transistor, having emitters connected together to  
11 ground through a series-connected resistors to ground and having bases  
12 connected to a first circuit node to which collector of said fourth transistor is  
13 connected;

14 a sixth transistor having a collector and a base electrode connected  
15 together to said first circuit node and having an emitter connected to a second  
16 circuit node formed between said series-connected resistors; and

17 a seventh transistor having a collector connected to said output  
18 terminal and an emitter connected to ground via a resistor and having a base  
19 electrode connected to said first circuit node.

NE-1150

- 16 -

1           9.     An active filter circuit having a plurality of resistors formed on  
2 a semiconductor substrate, comprising:  
3           a first current source for producing a first current of constant  
4 magnitude regardless of resistance variations which can occur uniformly in  
5 said resistors;  
6           a second current source for producing a second current of magnitude  
7 which is inversely variable with said resistance variations, said first and  
8 second current sources being connected to each other for producing an  
9 output current which is equal to a difference between said first and second  
10 currents; and  
11           an active filter driven by said output current for filtering an input  
12 signal.

1           10.    The active filter circuit of claim 9, wherein said active filter is a  
2 low-pass filter.

1           11.    The active filter circuit of claim 9, wherein said active filter  
2 comprises:  
3           a pair of switching circuits driven by said output current, said  
4 switching circuits alternately assuming a conducting state according to  
5 polarity of an input signal applied thereto; and  
6           resistor-capacitor circuitry connected across said switching circuits to  
7 produce an output signal.

1           12.    The active filter circuit of claim 9, wherein said second current  
2 is variable depending on an base-emitter voltage of a transistor.

NE-1150

- 17 -

1           13.    The active filter circuit of claim 9, wherein said second current  
2   is variable depending on a power-line voltage.

1           14.    The active filter circuit of claim 9, wherein said second current  
2   source is a band-gap type constant current source.

1           15.    An active filter circuit having a plurality of resistors formed on  
2   a semiconductor substrate, comprising:  
3           a first group of parallel transistors having emitters connected via  
4   respective resistors to a voltage source and having collectors connected  
5   together to an output terminal;  
6           a second group of parallel transistors having emitters connected via  
7   respective resistors to said voltage source and having collectors connected to  
8   each other;  
9           a constant current source connected between the collectors of said  
10   second group of transistors and ground to produce a constant current, said  
11   first and second groups of transistors having bases connected together to  
12   form a current mirror, whereby a current equal to said constant current is  
13   drawn by said first group of transistors to said output terminal; and  
14           transistor-resistor circuitry for drawing a current inversely variable  
15   with uniform resistance variations of said semiconductor substrate from said  
16   output terminal to ground;  
17           a pair of switching circuits driven by said output current, said  
18   switching circuits alternately assuming a conducting state according to  
19   polarity of an input signal applied thereto; and  
20           resistor-capacitor circuitry connected across said switching circuits to  
21   produce an output signal.

NE-1150

- 18 -

1           16.    The active filter circuit of claim 15, wherein one of said  
2   switching circuits comprises a first transistor and a second transistor  
3   connected in series between said voltage source and ground, and the other  
4   switching circuit comprises a third transistor and a fourth transistor  
5   connected in series between said voltage source and ground,  
6           said first and third transistors having bases connected together to  
7   receive said output current, and said second and fourth transistor connected  
8   to a pair of input terminals to which said input signal is applied,  
9           wherein said resistor-capacitor circuitry comprises:  
10          a resistor connected between collectors of said first and third  
11   transistors; and  
12          a capacitor connected between collectors of said second and fourth  
13   transistors for producing said output signal.

1           17.    The active filter circuit of claim 15, wherein said transistor-  
2   resistor circuitry comprises:  
3           at least one third transistor having an emitter connected via a resistor  
4   to said voltage source and a collector connected to a circuit node, whereby a  
5   current whose magnitude is equal to  $1/M$  of said constant current is drawn  
6   by said third transistor to said circuit node, where  $M$  is the number of  
7   transistors provided in each of said first and second groups of transistors;  
8           a fourth transistor having a collector connected to said output terminal  
9   and an emitter connected to ground via a resistor, said fourth transistor  
10   having a base electrode connected to said circuit node; and  
11          a fifth transistor having a collector connected to said circuit node and  
12   an emitter connected to ground via a resistor, said fifth transistor having a  
13   base electrode connected to the emitter of said fourth transistor.

NE-1150

- 19 -

1           18.    The active filter circuit of claim 15, wherein said transistor-  
2 resistor circuitry comprises:  
3           a pair of resistors connected in series between said voltage source and  
4 ground to form a circuit node therebetween; and  
5           a third transistor having a collector connected to said output terminal  
6 and an emitter connected to ground via a resistor, said third transistor having  
7 a base electrode connected to said circuit node.

1           19.    The active filter circuit of claim 15, wherein said transistor-  
2 resistor circuitry comprises:  
3           third and fourth transistors having emitters connected via respective  
4 resistors to said voltage source and having bases connected together to the  
5 bases of said first and second groups of transistors to produce from each of  
6 the third and fourth transistors a current whose magnitude is equal to  $1/M$  of  
7 said constant current, where  $M$  is the number of transistors provided in each  
8 of said first and second groups of transistors;  
9           a group of fifth transistors having collectors connected together to the  
10 collector of said third transistor, having emitters connected together to  
11 ground through a series-connected resistors to ground and having bases  
12 connected to a first circuit node to which collector of said fourth transistor is  
13 connected;  
14           a sixth transistor having a collector and a base electrode connected  
15 together to said first circuit node and having an emitter connected to a second  
16 circuit node formed between said series-connected resistors; and  
17           a seventh transistor having a collector connected to said output  
18 terminal and an emitter connected to ground via a resistor and having a base  
19 electrode connected to said first circuit node.